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EXPERIMENTAL STUDY FOR FLEXURE STRENGTH ON POLYPROPYLENE FIBER REINFORCED CONCRETE

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***ABSTRACT*:** *The main purpose of this paper is to study the effects of polypropylene fiber on the flexure strength of concrete. The experimental programmed was under taken to test standard concrete beam of size (150 X 150)mm with a span 700 mm for studying strength in flexure. The sample were compared without any fiber and with polypropylenes fiber of intensity 0.89 kg per cum of concrete. To provide a basis for flexure, reference specimens were cast without polypropylene fiber. The test results showed that the mechanical properties of flexural strength resulting from added of polypropylene fiber was relatively high.*

Keywords*: *Polypropylene Fiber, Polypropylene Concrete, Mix Design, Flexural Strength.

I. INTRODUCTION

The principal reason for incorporating fibers into a concrete is to increase the toughness and tensile strength and improve the cracking deformation characteristic of the resultant material. This paper deals specifically with the concrete reinforced with the polypropylene fibres. In modern times, a wide range of engineering materials (including ceramics, plastics, cement, and gypsum products) incorporate to enhance properties include tensile strength, compressive strength etc. Polypropylene fibers were suggested as an admixture to concrete in 1965 by cold Fein for construction of blast resistant buildings for the U.S. corps of engineers. The polypropylene is a versatile thermoplastic material, which is produced by polymerizing monomer unit of polypropylene molecules into very long polymer molecules, or chains in the presence of a catalyst under carefully, controlled heat and pressure. Polypropylene fiber then became available in two forms monofilaments fiber and fibrillated fiber. Polypropylene is hydrophobic.

EXPERIMENTAL STUDY

The aim of the experimental program is to compare the flexural strength of concrete made with and without polypropylene fibres used as coarse aggregates. Concrete mix for M_{20} grade was designed. The basic tests cared out on materials used for Mix Design are discussed in this paper, followed by a brief description about mix deign. At the end, the flexure strength testing conducted on the specimens and the result was noted.

MATERIAL USED

1.1 Cement

Grade 43 Ultra Tech OPC cement was used for casting beams for all concrete mixes. The cement was of uniform colour i.e. grey with a light greenish shade and was free from any hard lumps.

Consistency – 28.5 % Specific gravity – 3.15

1.2 Fine Aggregates

The sand used for the experimental programmed was locally procured and conformed to Indian Standard Specifications IS: 383-1970.

Table1 Sieve analysis of fine aggregate

Sieve size	Wt, Retain	Passing Wt.	% Passing
4.75 mm	27.61	1014.88	97.35

2.0 mm	82	932.88	89.48
1.0 mm	781.2	151.68	14.5
600µ	46.99	104.69	10.04
425µ	63.76	40.93	3.9
300µ	19.9	21.03	2.0
212µ	16.61	14.59	1.4
150µ	4.32	10.27	0.9
75µ	0.1	10.17	0.975

Table2 Properties of fine aggregates

S. No.	Characteristics	Value
1.	Type	Uncrushed (natural)
2.	Specific Gravity	2.6
3.	Water absorption	Nil
4.	Fineness modulus	6.82
5.	Grading zone	Zone-I

1.3 Coarse Aggregates

The material which is retained on BIS test sieve is termed as a coarse aggregate. The broken stone is generally used as a coarse aggregate.

Table3 Sieve analysis of 40 mm aggregates

Sieve size	Wt, Retain	Passing Wt.	% Passing
40 mm	0	10	100
20 mm	6.7	3.3	33
10 mm	3.2	0.1	1
6.75 mm	0.1	0	0
4.75 mm	0	0	0

Table 4 Properties of Coarse aggregates

S. No	Characteristics	Value
1.	Type	Crushed

2.	Maximum size	40 mm
3.	Specific gravity	3.13
4.	Total water absorption	2.0 %
5.	Fineness modulus	3.43

1.4 FIBRILLATED POLYPROPYLENE FIBRES

Properties of polypropylene fiber are shown in table specified by the supplier

Table 5 Properties of polypropylene fiber

S.No.	Properties	Value
1.	Specific Gravity -	0.91
2.	Bulk Density –	910 Kg/ Cum
3.	Water Absorption –	nil
4.	Tensile strength –	0.67 KN/Sq mm
5.	Form –	Fibrillated
6.	Dosage -	0.25% by weight of cement (i.e. .91 Kg per cum of Concrete)

II. MIX DESIGN

Mix proportion after doing mix design calculation

Water: Cement: Sand: Aggregate

170: 340 : 546.2: 1571.3

0.5: 1 : 1.6: 4.6

Actual Quantity required -

For 50 Kg of cement:-

Cement = 50 Kg

Sand = 80 Kg

Aggregate =230 Kg

Extra quantity of water to be added for absorption of CA at 2% of mass Water = 25Litres + 2%of 230 = 29.6 liters

Final Mix Proportions – 0.592: 1: 1.6: 4.6

III. FLEXURAL STRENGTH

Flexural strength is one measure of the tensile strength of concrete. It is a measure of an unreinforced concrete beam to resist failure in bending. It is measured by loading 150X150mm concrete beam with a span 700 mm at least three times the depth. The flexural strength is expressed as modulus of rupture in MPa and is determined by standard test method third point load loading (ASTM C78) or center point loading (ASTM C

293). In this paper the third point load method used because in this case pure bending can be easily find out without effect of shear. The sample were compared without any fiber and with polypropylenes fiber of intensity 0.89 kg per cum of concrete (or 125gm per 50 kg of cement).The concrete mix was made using ordinary Portland cement conforming SP-23 IS Hand book well graded 20 mm or 40 mm aggregates, 2.36mm down river sand and portable water. The mix proportion was finding by Mix design according IS 10262.The casting and testing of sample were done by following relevant IS codes. Samples are curing under the water in 21 and 28 days. Testing is performed after 21 and 28 days after casting. A total of at least three samples tested and the average values were taken for analysis.

IV. DETAIL TESTING FOR COMPRESSIVE STRENGTH

1.1. First phase of testing:- For 28 days

Six beams were manufactured under test conditions. The beams were three plain concrete beam and three beams with polypropylene fiber. The concrete were specimens were identified as shown in table.6.

Cement = 18.7Kg, Sand = 30.3 Kg, Aggregate = 63.6 Kg water = 9.35 liters Fibre = 47.3gm Temperature = $20^{O}C$

Table 6 for 28 days

Ident. Mark	Size of specimen(mm) B	D	L	Max. Load (kN)	Position of Failure From the nearest edge (mm)	Flexural Strength (N/mm^2)
1	150	150	700	22.4	320	4.645
2	150	150	700	24.0	330	4.977
3	150	150	700	20.0	345	4.148
Average Flexure Strength						4.590
With Fiber						
4F	150	150	700	26.0	250	5.392
5F	150	150	700	28.0	240	5.807
6F	150	150	700	27.0	330	5.600
Average Flexure Strength						5.60

1.2. Second phase of testing For 21 days

Six beams were manufactured under test conditions. The beams were three plain concrete beam and three beams with polypropylene fiber. The concrete were specimens were identified as shown in table7.

Cement = 18.7Kg, Sand = 30.3 Kg, Aggregate = 63.6 Kg water = 9.35 liters Fiber = 47.3gm Temperature =22 ^{O}C Humidity = 53%

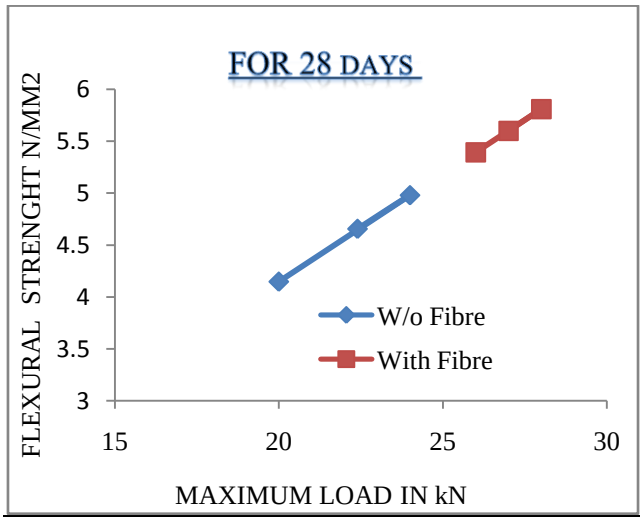
Table 7 for 21 days

Ident. Mark	Size of specimen(mm) B	D	L	Max. Load (N)	Position of Failure From the nearest edge (mm)	Deflection In mm	Flexural Strength (N/mm^2)
7F	150	150	700	20.0	340	.20	4.148

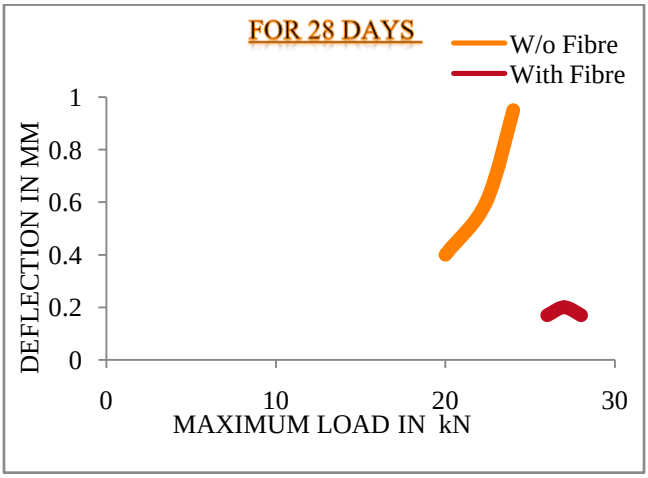
8F	150	150	700	20.8	280	.43	4.314
9F	150	150	700	16.0	340	.60	3.318
Average Flexure Strength 3.93							
With Fiber							
10	150	150	700	20.0	310	.60	4.148
11	150	150	700	20.2	320	.25	4.189
12	150	150	700	19.6	206	.45	4.065
Average Flexure Strength 4.134							

V. DISCUSSIONS

The result obtained in experimental work is presented in Graph1 and Graph2.



Graph1: Flexural Strength and Maximum loading for 28 days



Graph2: Deflection for 28 days

Fig1: Beam under loading without fiber

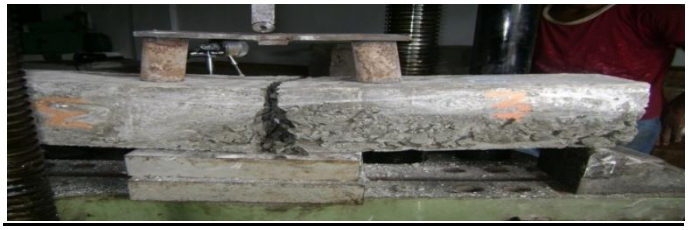


Fig2: Failure of Beam without fiber

Fig3: Beam under loading with fiber

Fig4: Failure of Beam with fiber

VI. OBSERVATIONS

1. For M20 mix considered in this investigation, there was about 18.5% increase in the ultimate load carrying capacity of the beams containing fibers when compared to the control beam specimens without fibers.
2. For M20 the mix, the beams with fibers showed significant increase in the deflection values when compared to the control beams. This phenomenon of increased deflections lays emphasis on the fact that the addition of fibers enhances ductility.
3. The increase in flexural strength is about 20% respectively that of plain concrete specimens.
4. The addition of fibers does not change the crack pattern as such but there were reduced crack widths, which were observed.

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